

# Paraffin Actuated Heat Switch for Mars Surface Applications

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**Abstract.** Missions to the surface of Mars pose unique thermal control challenges to rover and lander systems. With diurnal temperature changes greater than 100 °C, the presence of a Mars atmosphere, and limited power for night time heating the thermal control engineer is faced with a fundamental problem: how to successfully keep components above their survival or operating temperatures at night while managing higher environmental temperatures and dissipation rates during the day. Payload and avionics elements, among others, must be well insulated to survive night conditions at the risk of overheating during the day. This problem will be magnified in future missions as higher demand on electrical components will result in increased dissipations. One solution is a heat switch that changes thermal conductance to reject excess heat during the day and conserve heat during the night.

The Mars Exploration Rover (MER) mission which is currently being designed and built by the Jet Propulsion Laboratory (JPL) will be using a paraffin actuated heat switch as part of the thermal control system for the Rover secondary battery. This passive heat switch has been developed and qualified by Starsys Research Corporation for JPL. The switch is mounted between the battery assembly and an external radiator. Over a predetermined temperature range the switch heat conductance varies by nearly two orders of magnitude to regulate battery temperatures. The actuation of the heat switch is entirely mechanical and autonomous, relying on the temperature based expansion and contraction of paraffin.

Unique MER mission requirements have resulted in a stringent flight qualification program. The hard landing loads associated with the mission required the switch to withstand nearly 50 Gs. A dusty, CO<sub>2</sub> environment also posed unique challenges to the design. And planetary protection concerns required the assembly to provide a seal between the interior and exterior portions of the switch. This paper will describe the circumstances and events leading to the need for a heat switch as well as its development and qualification for flight. The heat switches are baselined on the MER mission to be launched in 2003.